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The objectives of this program is to develop a device processing technology necessary for proper utilization of Hg-based heterostructures and superlattices in device applications. The specific focus or long term goal guiding the direction of the program is to develop the devices and processing technology required for an IR focal plane integrated with on-board signal processing electronics.

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FINAL REPORT
DAAL03-87-0153 (1987-1990)

**Title: DEVICE PROCESSING OF II-VI SEMICONDUCTOR FILMS AND
QUANTUM WELL STRUCTURES**

Program Objectives

The objectives of this program is to develop a device processing technology necessary for proper utilization of Hg-based heterostructures and superlattices in device applications. The specific focus or long term goal guiding the direction of the program is to develop the devices and processing technology required for an IR focal plane integrated with on-board signal processing electronics.

Summary of the Most Important Results

- 1) First demonstration of CdTe metal semiconductor field effect transistors.
- 2) CdTe Schottky diodes with reverse breakdowns as high as 13.5 Volts and ideality factors of 1.2.
- 3) First demonstration of $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ metal insulator field effect transistors prepared using n-type layers grown by photoassisted molecular beam epitaxy. Demonstrated depletion and enhancement mode operation and a digital inverter circuit up to 1 MHz operation. These devices differ significantly from structures previously reported in that:
 - a depletion region rather than a surface inversion layer was used as the principle of device operation
 - larger x-value $\text{Hg}_{1-x}\text{Cd}_x\text{Te}$ is employed as the active region of the device
 - fabrication was done *without* ion implantation or thermal annealing
- 4) Developed a low temperature ($<60^\circ\text{C}$) device processing technology which included photoresist processing, metalization, and dielectric deposition.
- 5) First demonstration of Schottky diodes and field effect transistors in a diluted magnetic semiconductor ($\text{Cd}_{1-x}\text{Mn}_x\text{Te}$). The Schottky diodes had turn on voltages of 0.8 Volts, idealities between 1.27 and 1.7, and reverse breakdown voltages from 5.5 to 10.5 Volts.
- 6) Prepared both n-type and p-type CdTe using photoassisted molecular beam epitaxy.
- 7) Prepared CdMnTe-CdTe superlattices by photoassisted molecular beam epitaxy and measured effective lifetimes of 26 μs and 4 μs for CdTe and 75 μs and 10 μs for CdMnTe-CdTe superlattices.



8) Prepared HgTe-Cd_{0.85}Hg_{0.15}Te superlattices and determined the valence band offset $\Delta E_v = 420 \pm 100$ meV using optical absorption measurements.

9) Demonstrated both n- and p-type conductivity in small band gap HgTe-Hg_{1-x}Cd_xTe superlattices using modulation doping.

Personnel Supported/Degrees Granted

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**Publications for Final Technical Report
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